

The 2003 San Simeon Earthquake

At 11:16 AM PST on December 22, 2003, a Mw 6.5 earthquake occurred at about 10 km (6 miles) to the east of San Simeon, California at a depth of 7.6 km (4.5 mi), and at latitude 35.706N and longitude 121.102W. The earthquake occurred on a blind thrust fault in the Santa Lucia Mountains. The recorded waves indicate a reverse fault with the hanging wall situated to the southwest and the footwall to the northeast. This mechanism caused increased shaking and damage on the hanging wall to the southwest of the epicenter. The rupture propagated from the hypocenter to the southeast for about 20 km into the town of Templeton (just south of Paso Robles), which had the largest recorded ground motion of 0.48g, indicating rupture directivity from this earthquake (Figure 2.1). Unfortunately, there were few near-field recorded motions. Almost all the recordings were from the Parkfield array, 50 to 100 km to the east. The closest recording was the free-field station for the State Highway 1 San Simeon Creek Bridge, 13 km to the west of the epicenter. Despite the shallow depth, the fault did not appear to propagate to the surface during the earthquake.

The largest historical earthquake in the vicinity of the earthquake was the magnitude 6.2 Bryson earthquake of November 1952. The seismicity along the coast of Central California is dominated by the northwestward motion of the Pacific plate with respect to the North American plate. Most of the plate movement is accommodated by slip on major strike-slip faults, such as the San Andreas Fault, 60 km (37 mi) northeast of the earthquake epicenter and the San Simeon-Hosgri Fault Zone, 10 km (6.2 mi) west of the epicenter. Reverse faulting in the region is due to compressive stresses generated within this strike-slip plate-boundary zone.

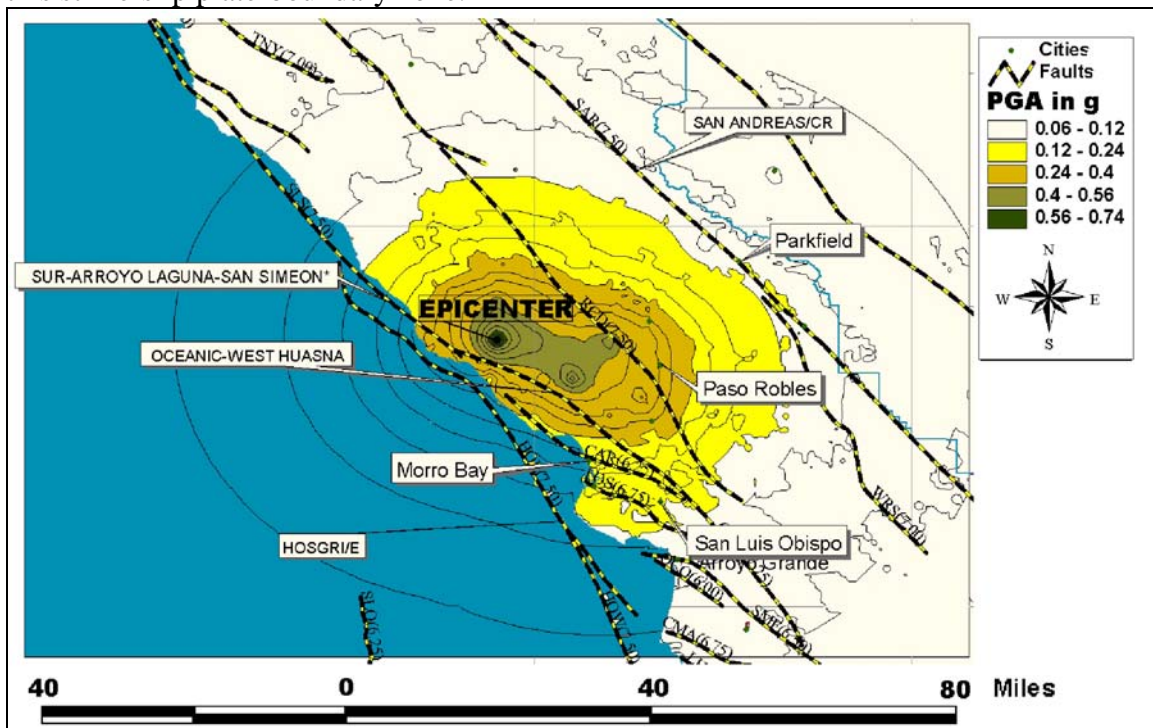


Fig. 2.1. ShakeMap of affected area with peak ground accelerations in g.

There was little damage to roads and bridges. A few roads were closed due to structures falling onto them. 12th Street in Paso Robles and Highway 1 in Cambria were closed until building debris could be removed. The earthquake occurred in the Santa Lucia Mountains and landslides closed several mountain passes.

This earthquake occurred on a blind thrust fault. Although this fault was not identified on Caltrans' hazard map, the peak accelerations were lower than those predicted for the Maximum Credible Earthquake in the region. Obviously, more work needs to be done to identify the complicated faulting in this area.

Caltrans' Office of Structures Maintenance immediately dispatched six teams of engineers to inspect all bridges in the area. Despite (or because) of the upcoming Christmas holiday, some 600 bridges were inspected within 24 hours of the earthquake.

The San Simeon Creek Bridge 13 km (8 mi) from the epicenter was the only Caltrans' structure that recorded the ground motion ($PGA=0.18g$). Unfortunately, the structural sensors had been removed for repair. Caltrans imported the California Geological Survey's Shakemap onto a map of roads and bridges as a tool to identify potential bridge damage for the post-earthquake inspection teams (Figure 7.1).

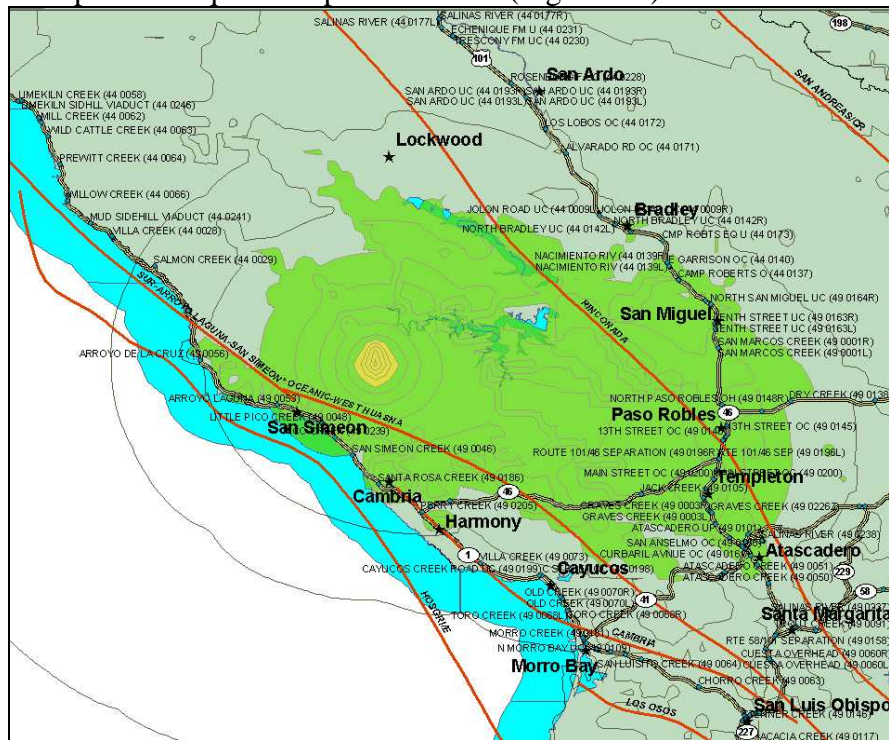


Fig. 7.1. Shake Map Highway and Bridge Overlay

The most significant road damage was at State Routes 41 and 46 between US-101 and SR-1 (Figures 7.2 and 7.3). Ron Richman, the District 5 geotechnical engineer writes, *"We observed rockfalls originating from cut slopes on State Route 41. The Route 46 damage included surging of landslides, spreading of tall embankments and fissuring at*

the contacts between the original ground and tall embankments. We did not observe significant effects on the bridges in the region. We looked for indications of liquefaction, but found none.” This damage was sufficient to keep Caltrans’ road crews busy with traffic control and roadway repairs for several weeks after the earthquake.



Fig. 7.2. Map showing major damage locations for roads and bridges.



Fig. 7.3. Cracks in State Highway 4

Villa Creek Bridge, 11 km (7 miles) north of San Luis Obispo County, was the only Caltrans structure that was damaged during the earthquake (Figure 7.4). This is a five simple-span, precast girder structure on State Highway 1, along the Pacific Coast. The deck is supported on tall single column bents. The bridge was recently retrofit, which didn't protect it from a rockslide that put a hole in the northeast girder web (Figure 7.5). However, this damage did not reduce the girder's ability to carry traffic and the bridge remained open following the earthquake.



Fig. 7.4. Villa Creek Bridge



Fig. 7.5. Villa Creek Bridge Damage

The Templeton Road Bridge spans over the Union Pacific Railroad and the Salinas River. The west two spans are cast-in-place (CIP) girders and the east five spans are reinforced concrete box girders. The superstructure is on flared, single column bents with piles and on seat and end diaphragm abutments on spread footings. The bridge was not retrofit. Most of the damage was due to liquefaction, settlement, and shaking of the superstructure. The approaches settled about 5 inches (12.5 centimeters) and the barrier rail was damaged (Figure 7.6). The conduits under the bridge for utility lines (Figure 7.7) were also damaged. Soil borings were taken before asphalt was placed to repair the approaches.



Fig. 7.6. Approach Settlement and Barrier Rail Damage



Fig. 7.7. Broken Conduits Under Bridge

A saltwater lagoon in Oceano frequently floods its banks. This part of town was built on the loose, saturated alluvium carried by these floods. This soil liquefied during the earthquake causing considerable damage. There are three timber trestle bridges that cross over the lagoon and they were all damaged due to lateral spreading. The seat-type abutments moved toward the lagoon cracking the timber stringers and splitting the timber bent caps (Figure 7.8). These bridges look fairly new and the lumber appears to have been recently purchased.



Fig. 7.8. Broken Bridge Timbers.